

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



GENERAL VIEW OF THE OUED SOUF REGION FROM THE TOWN OF EL OUED, SHOWING SAND DUNES AND SUNKEN GARDENS OF DATE PALMS.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 86.

B. T. GALLOWAY, *Chief of Bureau.*

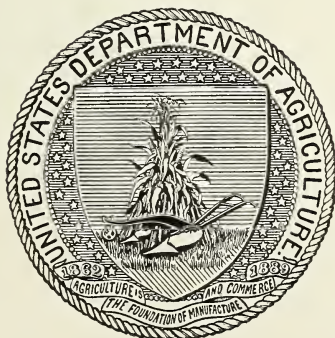
AGRICULTURE WITHOUT IRRIGATION IN THE SAHARA DESERT.

BY

THOMAS H. KEARNEY,
PHYSIOLOGIST.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL
INVESTIGATIONS.

ISSUED NOVEMBER 16, 1905.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY,

Pathologist and Physiologist, and Chief of Bureau.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ALBERT F. WOODS, *Pathologist and Physiologist in Charge, Acting Chief of Bureau in Absence of Chief.*

BOTANICAL INVESTIGATIONS.

FREDERICK V. COVILLE, *Botanist in Charge.*

FARM MANAGEMENT.

W. J. SPILLMAN, *Agriculturist in Charge.*

POMOLOGICAL INVESTIGATIONS.

G. B. BRACKETT, *Pomologist in Charge.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

A. J. PIETERS, *Botanist in Charge.*

ARLINGTON EXPERIMENTAL FARM.

L. C. CORBETT, *Horticulturist in Charge.*

INVESTIGATIONS IN THE AGRICULTURAL ECONOMY OF TROPICAL AND SUB-TROPICAL PLANTS.

O. F. COOK, *Bionomist in Charge.*

DRUG AND POISONOUS PLANT INVESTIGATIONS, AND TEA CULTURE INVESTIGATIONS.

RODNEY H. TRUE, *Physiologist in Charge.*

DRY LAND AGRICULTURE AND WESTERN AGRICULTURAL EXTENSION.

CARL S. SCOFIELD, *Agriculturist in Charge.*

EXPERIMENTAL GARDENS AND GROUNDS.

E. M. BYRNES, *Superintendent.*

SEED LABORATORY.

EDGAR BROWN, *Botanist in Charge.*

J. E. ROCKWELL, *Editor.*

JAMES E. JONES, *Chief Clerk.*

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

SCIENTIFIC STAFF.

ALBERT F. WOODS, *Pathologist and Physiologist in Charge.*

ERWIN F. SMITH, *Pathologist in Charge of Laboratory of Plant Pathology.*

HERBERT J. WEBBER, *Physiologist in Charge of Laboratory of Plant Breeding.*

WALTER T. SWINGLE, *Physiologist in Charge of Laboratory of Plant Life History.*

NEWTON B. PIERCE, *Pathologist in Charge of Pacific Coast Laboratory.*

M. B. WAITE, *Pathologist in Charge of Investigations of Diseases of Orchard Fruits.*

MARK ALFRED CARLETON, *Cerealist in Charge of Cereal Laboratory.*

HERMANN VON SCHRENK, *in Charge of Mississippi Valley Laboratory.*

P. H. ROLFS, *Pathologist in Charge of Subtropical Laboratory.*

C. O. TOWNSEND, *Pathologist in Charge of Sugar Beet Investigations.*

T. H. KEARNEY, A. D. SHAMEL, *Physiologists, Plant Breeding.*

P. H. DORSETT,^a CORNELIUS L. SHEAR, WILLIAM A. ORTON, W. M. SCOTT, ERNST A.

BESSEY, E. M. FREEMAN, *Pathologists.*

E. C. CHILCOTT, *Expert in Cultivating Methods, Cereal Laboratory.*

C. R. BALL, *Assistant Agrostologist, Cereal Laboratory.*

JOSEPH S. CHAMBERLAIN,^b J. ARTHUR LE CLERC,^c *Physiological Chemists.*

FLORA W. PATTERSON, *Mycologist.*

CHARLES P. HARTLEY, KARL F. KELLERMAN, JESSE B. NORTON, CHARLES J. BRAND,

T. RALPH ROBINSON, *Assistants in Physiology.*

DEANE B. SWINGLE, GEORGE G. HEDGCOCK, *Assistants in Pathology.*

PERLEY SPAULDING, P. J. O'GARA, FLORENCE HEDGES, HENRY A. MILLER, ERNEST B.

BROWN, LESLIE A. FITZ, LÉONARD L. HARTER, JOHN O. MERWIN, A. H. LEIDIGH, H. F.

BLANCHARD, *Scientific Assistants.*

W. W. COBEY, *Tobacco Expert.*

JOHN VAN LEENHOFF, JR., T. D. BECKWITH, *Experts.*

^a Detailed to Seed and Plant Introduction and Distribution.

^b Detailed to Bureau of Chemistry.

^c Detailed from Bureau of Chemistry.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., September 6, 1905.

SIR: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 86 of the series of this Bureau the accompanying paper, entitled "Agriculture without Irrigation in the Sahara Desert."

This paper was prepared by Mr. Thomas H. Kearney, one of the physiologists of this Bureau, and the data for it were obtained on a trip which he made to northern Africa for the Office of Seed and Plant Introduction and Distribution, primarily for the importation into the United States of offshoots of valuable Tunisian date varieties. It is believed that the methods described may be useful in some cases in our southwestern desert regions where date culture is being introduced.

The accompanying illustrations are necessary to a clear understanding of the text of this bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

In view of the interest in farming without irrigation that is now being manifested in the arid portion of the United States, an account of a region where agriculture is carried on under extremely adverse natural conditions is particularly timely. The present paper deals with a highly developed system of date-palm culture in the Oued Souf, a remarkable and little-known part of the Sahara Desert in northern Africa. Strictly speaking, it is not dry-land agriculture with which we have to do in the Souf region, for while the rainfall is practically nothing and irrigation is impracticable, the roots of the trees quickly find their way to ground water. However, it is quite possible that similar conditions may be found to exist in this country in some parts of the desert region of the Southwest, and that the Souf system, with or without irrigation, can be utilized there on a small scale in growing certain orchard crops with a view to forcing fruit to early maturity, so that it can be put upon the market much in advance of the bulk of the crop.

The Oued Souf was visited by Mr. Kearney at the end of November, 1904, the journey having been made from Nefta, in southwestern Tunis, where he had spent several weeks in a study of the date palm. This expedition to northern Africa was made under the auspices of the Office of Seed and Plant Introduction and Distribution of the Bureau of Plant Industry.

Acknowledgment is here made to Captain Bussy, Chef du Bureau Arabe at El Oued, for the cordial assistance rendered by him to Mr. Kearney during the latter's stay in the Souf region.

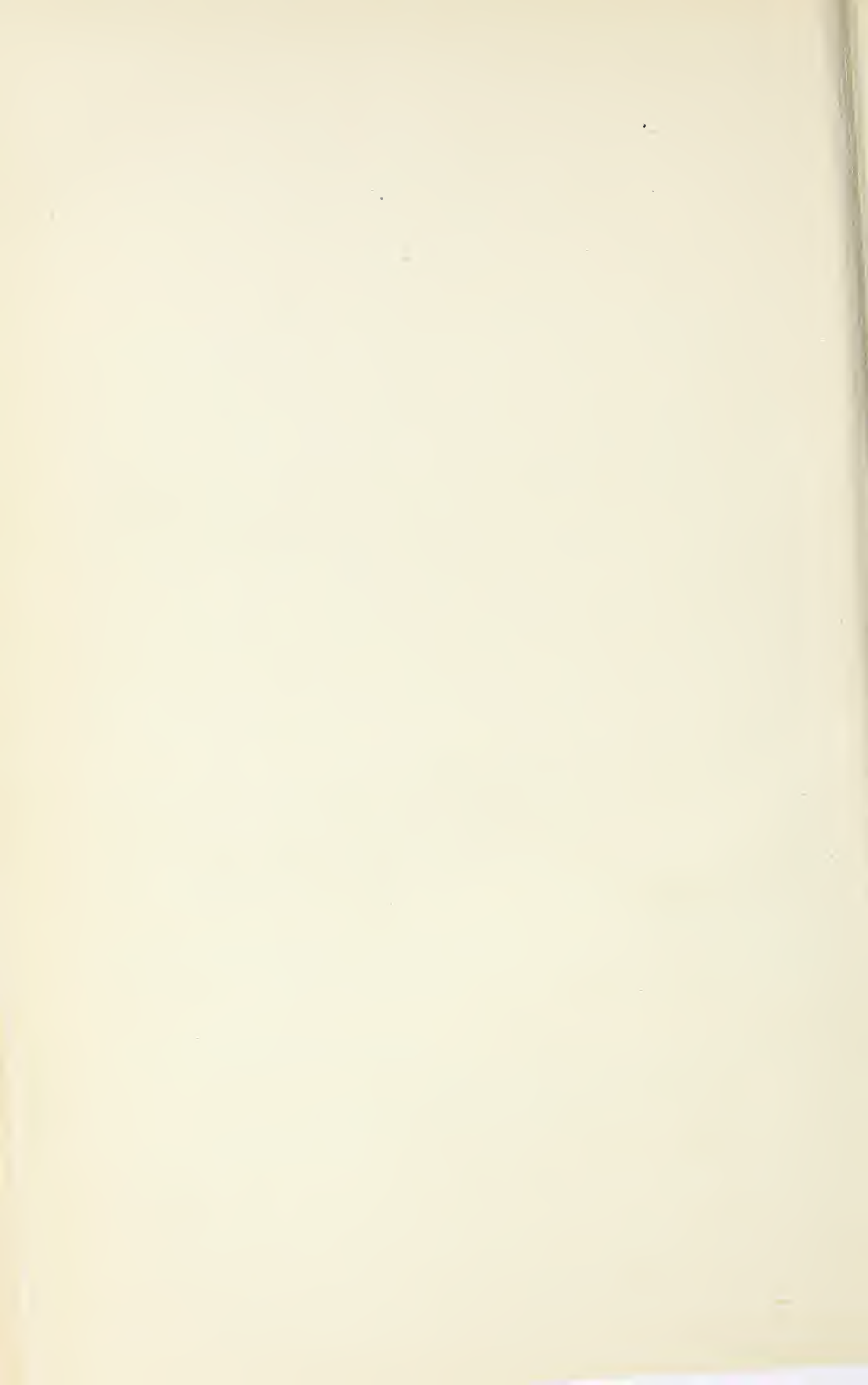
A. F. WOODS,

Pathologist and Physiologist.

OFFICE OF VEGETABLE PATHOLOGICAL

AND PHYSIOLOGICAL INVESTIGATIONS,

Washington, D. C., August 22, 1905.



CONTENTS.

	Page.
Introduction	9
Population	12
Climate	13
Water supply	16
Soils	18
The date gardens	18
Planting	19
Care of palms	21
Fighting the sand	22
Manuring	22
Harvest	24
Yields	25
Varieties chiefly grown	25
Conclusion	27
Description of plates	30

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. General view of the Oued Souf region from the town of El Oued, showing sand dunes and sunken gardens of date palms.	Frontispiece.
II. Fig. 1.—High sand dunes east of El Oued. Fig. 2.—A typical dwelling house of the Oued Souf, showing its cubical form and roof composed of flattened cupolas. Fig. 3.—General view of the Oued Souf region, showing sunken date gardens and sand dunes.	30
III. Fig. 1.—Near view of sunken palm garden and surrounding dunes. Fig. 2.—Gradual extension of a palm garden by cutting down bordering sand hills. Fig. 3.—Vegetable garden irrigated by well near bottom of basin in which date palms are grown.	30
IV. Fig. 1.—Hole on slope of dune near bottom of basin in which a young palm is planted. Fig. 2.—Camel manure ready for application in a date garden.	30
V. Fig. 1.—“Dokana,” or mound of earth and plaster for strengthening the base of a palm. Fig. 2.—Rhars palm, showing thickness of trunk.	30

TEXT FIGURE.

FIG. 1. Map showing location of the Oued Souf with respect to other localities in Algeria and Tunis.	10
--	----

AGRICULTURE WITHOUT IRRIGATION IN THE SAHARA DESERT.

INTRODUCTION.

In the great desert of northern Africa, stretching across in a belt from southeastern Algeria to the borders of Tripoli, is the region known as the "Erg." It is a land of enormous sand hills, some of which reach a height of 500 feet. Chain after chain of these great dunes, with knife-edge summits and steep slopes and trough-like valleys between, extend diagonally northeast and southwest across this part of the Sahara. (Pl. II, fig. 1.) It is like an ocean caught in a raging storm, with its huge billows rising skyward and held fixed and motionless. Not a leaf nor a blade of grass, not a boulder nor a pebble mars the smoothness of the sand. Never is the least trace of water to be seen on its surface. The few drops of rain that fall at rare intervals are drunk up as soon as they touch the thirsty ground. Pure quartz sand it is, light yellow in color and so fine of grain that the least breath of air sends a little cloud of it curling off the sharp crests of the ridges. When a hard wind blows the air is filled with it, the sun is blotted out at noonday, and the traveler can hardly see his horse's head in front of him. The sharp-cornered particles of sand sting his face and blind and bewilder him. The vague tracks of camels and donkeys, the only roads through this wilderness, are quickly covered up, all landmarks disappear, and without an experienced guide one is sure to be hopelessly lost.

It is a desolate and unfriendly landscape, yet at times not without a weird beauty of its own. When the sun is high the glare is blinding and there is little to attract one in the scene. But in the early morning and the late evening the sand assumes a golden color, and the dense black shadows cast by the dunes bring out their contours in sharp relief. Then their surface is seen to be modeled by series of delicate ripple marks left by the wind, and one finds it hard to believe that when he climbs the next high ridge he will not see the ocean at his feet.

Who would suspect that amid these mountains of bare sand, where even the hardy shrubs and grasses of the desert find no foothold,^a men can live by the products of the soil? Yet in the very heart of the Erg, two long days' ride east or west from the nearest habitations, there exists one of the most highly developed agricultural communities in the world. This is in the country known as the Oued Souf, situated in extreme southeastern Algeria (see fig. 1), about midway between the oases of southwestern Tunis and the Algerian oases known as the Oued Rirh, in which latter the date palm is grown by

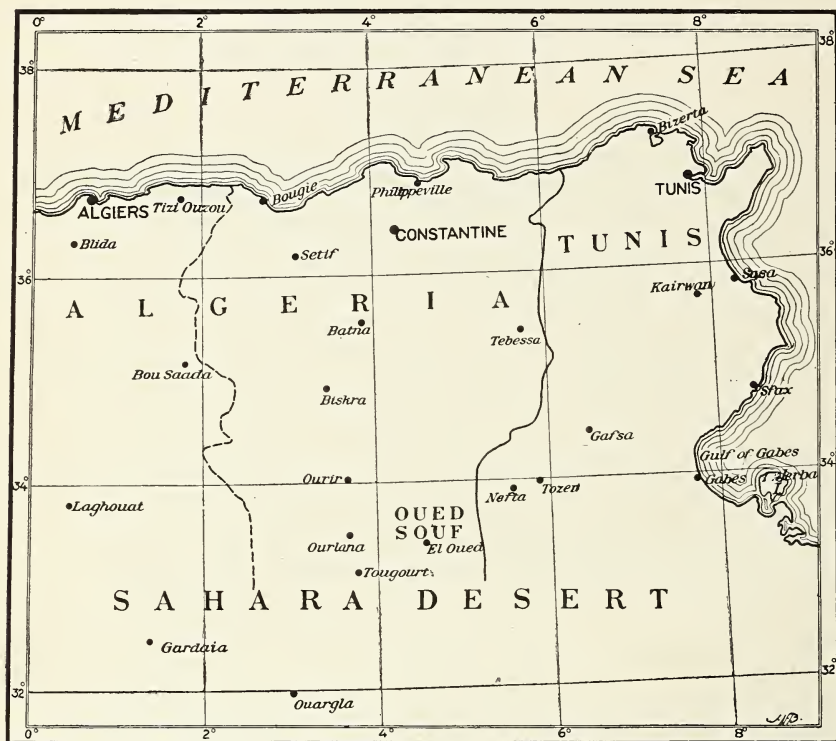


FIG. 1.—Map showing location of the Oued Souf with respect to other localities in Algeria and Tunis.

Europeans upon a commercial scale.^b From El Oued, the capital of the Souf, it is about 70 miles southwest to Tougourt, the chief town of the Oued Rirh, and about the same distance northeast of El Oued is Nefta, the nearest oasis in Tunis. The elevation of El Oued is about 257 feet above sea level.

^a Only eight species of flowering plants were found growing wild in the Souf region by Massart. See "Un voyage botanique au Sahara," p. 249 (1898).

^b See Plate II (map) in Bul. 53, Bureau of Plant Industry, "The Date Palm," by W. T. Swingle.

From the tops of the lofty sand hills that surround El Oued an excellent view can be had, and there one can form a clear idea of the character of this remarkable country. (See Pl. I, frontispiece, and Pl. II, fig. 3.) Assuredly there are few regions where any sort of agriculture is carried on under more extraordinary conditions. As far as the eye can reach it rests upon an expanse of pure sand, heaved up into range after range of dunes.^a In the hollows among these dunes are the gardens of date palms, sometimes mere pockets containing 10 or 20 trees, sometimes larger basins in which are groves of 50 to 100 palms.

Often the bordering sand hills are much higher than the tallest of the palms, so that many of the gardens can not be seen until one is on the very edge of the basin. In other places, however, the ridges are lower or gaps occur, allowing a cluster of feathery crowns to peep through. These are of such a dark green as to look almost black against the pale sand. A more striking contrast of colors could not be imagined. The trunks are rarely seen until one reaches the brink of the basin or pocket in which the palms are growing.

We have before us, in short, a network ^b of basins or hollows containing small groves of date palms and separated by great hills and ridges of sand. The aspect of the country is wholly different from the Oued Rirh in Algeria and the Djérid in Tunis, where each oasis is a dense continuous forest of date palms, containing often several hundred thousand trees,^c and situated upon comparatively level land.

Such, then, is the country of the Souf, a land where there is practically no rainfall, where there are no streams nor springs nor flowing wells to furnish water for irrigation, where the soil is a pure hard sand devoid of organic matter and blown about in clouds by every wind, so that unceasing vigilance is needed to keep the gardens free from it, and where the summer heat is almost as great as anywhere in the world. Yet here the date palm grows to perfection, yielding fruit of better quality and in larger quantity than elsewhere in the Sahara. How this has been brought about we shall presently see in these pages; but first we should know what manner of men are they who have developed a flourishing agriculture in a land where Nature seems to frown most severely upon all efforts to win a living from the soil. The race that has succeeded so well in the face of such tremendous obstacles must needs be an interesting one.

^a The surface of these dunes is easily moved, even by a light breeze, but the core is said to be stationary and composed of stratified materials.

^b The Arab word "erg" (plural areg) means "a vein."

^c In 1899 there were only 192,000 date palms in bearing in the entire Souf region.

POPULATION.

There are about 25,000 people in the Souf region, 5,500 of whom inhabit the capital town, El Oued, and its immediate neighborhood. Several distinct tribes are included in this population, some being chiefly nomadic shepherds, and others more sedentary, devoting most of their time to the care of their gardens. They are for the most part a healthy and strong looking race, and are much more energetic than the inhabitants of other north African oases. This is doubtless partly due to the unceasing labor demanded by the conditions under which they live and partly to the fact that their climate is a healthful one, despite the intense heat of summer. There is no standing water nor even moist surface soil, and mosquitoes are said to be unknown. The dry air and the hot sand are not friendly to the germs of contagious diseases. The conditions are, therefore, very different from those in other oases of the Sahara, which are so overirrigated as to be mere swamps in summer, scourged with malarial fevers.

The inhabitants of the Souf region, who are called "Souafas," depend for a livelihood largely upon the products of their gardens, but they have other resources as well. The more nomadic tribes possess flocks of sheep and goats. They have almost a monopoly of the trade of camel drivers in a large part of the Sahara, guiding caravans eastward into Tunis, westward to Biskra, and far south into the heart of the great desert. Their camels are considered the largest and finest of the Sahara. The men of the Souf are indefatigable walkers, thinking nothing of traveling 20 or 25 miles a day through the loose sand. Their camel's-hair shoes, tightly bound around the ankles, are much better adapted to this sort of travel than the loose-fitting, heelless slippers generally worn by the Arabs.

In building their houses, as in cultivating their palms, the Souafas have many difficulties to contend with that are not experienced by the dwellers in other oases. Elsewhere in the Sahara, sun-dried brick, like the Mexican adobe, is the universal building material. But in the Oued Souf there is no clay to be had. Consequently the town of El Oued and all the villages of the region are constructed with irregular masses of grayish, crystalline, gypseous rock, cemented by plaster made from the same material, which thus furnishes both stone and mortar. Wood being very scarce, the roofs are not flat, wooden ones, but consist of rows of small, flattened cupolas, not unlike old-fashioned beehives, which give a very odd look to the cube-shaped houses. (Pl. II, fig. 2.) In its architecture, as in everything else, the Souf is unique. The immaculate cleanliness of the villages is surprising to the traveler who is familiar with the filthy streets of most Arab towns. The pure, dry sand is constantly drifting among the houses, and quickly buries all refuse.

CLIMATE.

Exact data in regard to the climate of the Oued Souf are not easily obtainable. The observations here given were made chiefly by a medical officer of the French army during the summer of 1884.^a Unfortunately records covering a period of several years are not available.^b

The summer temperatures are very high, few hotter localities being known in the Sahara. The monthly maximum shade temperatures observed by Escard in the summer of 1884 are as follows (in degrees Fahrenheit):

April -----	93	August -----	116.5
May -----	100	September -----	113
June -----	106	October -----	91.5
July -----	122		

In June, 1904, a maximum of 127.5° F. is said to have been reached. The sum total of temperature during the summer, a factor of the greatest importance in the ripening of the finer varieties of dates, is said to be greater in the Oued Souf than in the Oued Rirh and the Djérid. At the time of the writer's visit (November 22-26, 1904) cool, cloudy weather prevailed, and the nights were decidedly cold.

^a Escard. *Etude médicale et climatologique sur le pays de l'Oued Souf*. Archives de Méd. et de Pharm. Milit., 7: 33 (1886).

^b Since the above chapter on climate was written the records of observations made at El Oued during the whole of 1904 and parts of 1903 and 1905 have been received, through the courtesy of the Director of the Meteorological Service of Algeria. These observations necessitate some modifications in the previously written discussion of the climate of the Souf. The absolute maximum temperature at El Oued in 1904 was 121.8° F. in May instead of 127.5° F. in June. The absolute minimum in 1904 was 32° F. The mean relative humidity during 1904 at El Oued was 58.8, which is lower than the normal at Tozer, in Tunis (60.8), but higher than the normal at Ouargla and Biskra, Algeria (47.2 and 48.4, respectively), and at Yuma, Ariz. (42.9). The sum of the monthly means of evaporation at El Oued in 1904 is 156 inches, while the normal at Tozer is 94 to 98.5 inches. The total precipitation at El Oued in 1904 was 3.23 inches, while the normal yearly total is 3.61 inches at Ouargla, 6.73 inches at Biskra, 5.1 inches at Tozer, and 2.83 inches at Yuma.

The observations on the prevailing direction of the wind during 1904 and the first half of 1905 do not agree with those made by Escard and quoted in the text, but the data are insufficient for an adequate discussion of this factor.

As the climatic factor which is most important in date growing is probably the effective temperature during the ripening season, a calculation has been made of the sum totals of daily mean and of daily maximum temperatures above 64.4° F. (18° C.) during the months of May to October, 1904, at El Oued, and, for the sake of comparison, of the sums for the same months of the same year at Ouargla and Biskra, Algeria; Tozer, in Tunis, and Mecca, in the Salton Basin, California. Records at Mecca for May and June, 1904, not being available, the records for those months at Imperial, Cal., were substituted in making

Almost every winter freezing temperatures are reached, although probably the minima are higher and frosts are less frequent in the Oued Souf than at Tougourt and at Tozer. In the winter of 1903-4 the absolute minimum was 32° F., and for several preceding winters 27° F.

In respect to atmospheric humidity, the absence of surface water probably tends to keep the air drier than is generally the case in the oases of the Sahara.

The rainfall is said to be even less than in the Oued Rirh, where the average yearly precipitation (at Tougourt) is only 5.3 inches. Most of the rain is divided between two periods—October to November, and February to March. The rains are generally torrential in character and fall during several successive days, with intervals of sunshine.

The sky is nearly always clear in summer. Toward the end of August light clouds appear in the morning and evening, but no rain falls until October. During the writer's four days' visit to the Souf

the calculations for Mecca, experience having shown that the temperatures recorded at Mecca and at Imperial are very nearly identical.

TABLE I.—*Sum of daily mean temperatures above 64.4° F. (18° C.) from May 1 to October 31, 1904.*

Locality.	Degrees Fahrenheit.	Degrees centigrade.
El Oued, Algeria	3,672.6	2,040.3
Ouargla, Algeria	3,961.3	2,200.7
Biskra, Algeria	3,140.4	1,744.6
Tozer, Tunis	3,831.3	2,128.5
Mecca, Cal	3,591.5	1,995.3

The sum of daily means at Biskra for 1904 is nearly 200° F. lower than the normal, as based upon observations covering a period of 10 years (see W. T. Swingle, Bul. No. 53, Bureau of Plant Industry, p. 66), and the sum at Mecca for that year is about 400° F. lower than the normal for Indio, Cal., a few miles distant.

TABLE II.—*Sum of daily maximum temperatures above 64.4° F. (18° C.) from May 1 to October 31, 1904.*

Locality.	Degrees Fahrenheit.	Degrees centigrade.
El Oued, Algeria	6,325.7	3,514.3
Ouargla, Algeria	6,501.6	3,612.0
Biskra, Algeria	5,219.1	2,899.5
Tozer, Tunis	5,903.6	3,279.8
Mecca, Cal	6,370.1	3,539.0

In calculating the sums of daily maximum temperatures allowance was made for mean monthly minima falling below 64.4° F., in accordance with the practice suggested by Swingle (*ibid.*, p. 67). The sum of daily maximum temperatures at Biskra during May to October, 1904, is about 250° F. lower than the normal for 12 years (Swingle, *ibid.*, p. 68). The sum for Mecca is about 700° F. lower than that for Imperial, Cal., in 1902.

at the end of November the sky was overcast about half of the time, and there were occasional gusts of cold, drizzling rain.

Winds are probably more frequent and more violent in the Oued Souf than in the other groups of oases mentioned. It would appear, in fact, that windiness is the ordinary condition there. During the winter, northwest and northeast winds prevail. From April to October, however, the wind is generally from the south (the sirocco) or the southeast (the simoom). The sirocco is the hottest wind, but is less frequent than the simoom, which is generally more violent and transports more sand. All these are winds that blow more or less steadily for several hours and often days at a time. Cyclonic sand storms also occur, arising suddenly and lasting but a short time. Such storms are never accompanied by rain.

Owing to the lack of natural vegetation (see Pl. II), and the fineness of the sand with which the country is covered, strong winds carry with them a great deal of material, so that the face of the land is being constantly altered. This is shown by the fact that an apparently fresh wagon track noticed by the writer on his journey from Nefta was completely buried in many places by large heaps of sand. During his four days' stay in the Souf country, a strong wind blew constantly, often making travel difficult, as the particles of sand stung the face and made it hard at times to keep the eyes open. The air was frequently so full of sand that one could see but a few rods ahead.

The slopes of the dunes that border the gardens are very steep, so that when a heavy wind is blowing much sand rolls down upon the floor of the garden. Generally there is a fence or palisade along the crest of the dunes, made by sticking palm leaves or pieces of gypsum rock close together (Pl. II, fig. 3; Pl. III, fig. 1; Pl. IV, fig. 1), but this only partly arrests the blowing and drifting sand, and it is necessary to remove it frequently from the gardens. The task is a laborious one, as the sand must be carried up the steep hillside in baskets and dumped on the outer slope of the dunes. But if it were neglected, in a few years the trees would be buried, especially in smaller gardens. The writer saw several little gardens that had been abandoned by their owners where the basin was almost filled and only the crowns and a small part of the trunks of the trees still projected above the soil.

Another injurious effect of the sand-carrying winds is that when harvested the dates always have more or less sand adhering to the skin, and this must be brushed or washed off before they are fit for export. Dates that had been kept for some weeks in the houses of natives, and even those freshly gathered from the trees, were very unpalatable to the writer on this account; although the Souafas themselves do not seem to mind eating a good deal of sand with their dates.

WATER SUPPLY.

There is no surface water in the whole Souf country, excepting, possibly, a small sebka, or salt pond, of which the writer was told, but which he did not see. There are no natural springs, although ground water is everywhere very near the surface in the hollows among the dunes. It is said to occur sometimes in strata of pure quartz sand, sometimes in gypseous sand. The distance to standing water is said to reach as much as 40 feet in different parts of the region, although averaging considerably less; but in the bottoms of the basins in which date palms are grown it is encountered often at a depth of only 2 or 3 feet below the surface of the soil, thanks to the extensive excavation that has been done. In one garden, near the town of El Oued, the writer saw water standing at a depth of 6 feet in a large hole that had been dug to receive manure. The Souf oases are believed to mark the course of a buried Quaternary stream: Oued Souf means "murmuring river."^a

As we shall presently see, the date palm is not irrigated in the Souf country, receiving at most a few waterings by hand during the first summer after planting. In almost all the gardens, however, shallow wells occur,^b the water of which is used for household purposes and for irrigating small plats of garden vegetables. (Pl. III, fig. 3.) These are generally situated on the slope of the bordering dunes, 10 feet or less above the bottom of the basin, and water stands in them at a depth of 10 to 16 feet. In the town of El Oued the wells are much deeper than in the gardens, water standing in them at 30 to 40 feet. All this water is under a slight pressure, rising in the wells about 1.5 feet higher than the general water table. Small gardens of vegetables and tobacco,^c irrigated from deeper wells, are also located in some parts of the region far above the bottoms of the basins. Practically no grain is raised, wheat and barley being brought by caravan from other parts of Algeria and from Tunis, to be exchanged for dates.

^a It is difficult to obtain a very satisfactory idea as to the distribution of the ground water in the Souf region, its depth at various points, and the amount of excavation necessary to enable the roots of the palms to reach it easily. The natives themselves give the most conflicting answers to questions upon this subject, and there are serious discrepancies in the accounts that have been published by French authorities upon irrigation. The whole matter evidently needs to be carefully studied by competent hydrographers, a study which is certainly warranted by the rarity of this type of agriculture.

^b In 1883 Rolland estimated that there were 4,431 wells in the Souf region.

^c Tobacco growing, which is unrestricted in Algeria, is a profitable industry in the Souf country on account of that region's nearness to the frontier of Tunis, where the growing of this crop is forbidden by law and where the selling of tobacco is controlled by the government. Agents of the Tunisian tobacco monopoly frequently visit the Oued Souf to purchase supplies.

The plats of vegetables that are irrigated from wells in the date gardens are situated on terraces constructed in the side of the sand hills, usually 10 feet or less above the floor of the basin. (Pl. III, figs. 1 and 3.) The well water is raised by hand in a shallow bucket, generally made of basketware covered outside with pitch, but sometimes of goatskin, which is hung on the small end of a slender palm trunk and counterpoised by a piece of rock fastened to the large end. The pole is fastened by its center to a crosspiece that is supported by two vertical posts made of stouter palm logs or of cemented rock. The bucket is emptied into a little cement basin adjoining the well curb, whence the water flows through a system of small conduits into the plats that are to be irrigated. Flood irrigation alone is practiced. As there is no soil in the region from which ditch banks and ridges that will stand up when wet can be made, the conduits and ridges of the plats, as well as the lining and curb of the well, are made of the same dark-gray plaster with which the walls of the houses are cemented. Plugs of wool are used for stopping the conduits at places where water is to be diverted into the plats. Among the vegetables most commonly grown are cabbages, turnips, radishes, carrots, pumpkins, melons, watermelons, onions, tomatoes (a small-fruited sort), and peppers.

In parts of the Souf region, especially east of the capital town, El Oued, the water of the wells is said often to contain enough magnesium and other salts to make it disagreeable for drinking.^a West of the town, on the other hand, the water is said to be generally very pure. The difference is thought to be sufficiently great to have a marked effect upon the quality of the dates, the most renowned Deglet Noors of the Souf region being produced near the village of El Amiche, where the water is purest. The peculiar character of the water supply of the Oued Souf is not without advantages. Eminent authorities are of the opinion that the underground sheet is abundant and that it is much less liable to exhaustion than in the Oued Rirh, where numerous flowing artesian wells exist.

^a Well water in the Souf, according to an analysis cited by Jus (Les oasis du Souf du Département de Constantine, Bul. Acad. d'Hippone, No. 22, p. 67 (1886), has the following contents of solid matter in grams per liter of water:

Sulphates	1.9993
Chlorids7769
Carbonates2999
Nitrates and dissolved organic matter0690
Silicates, etc., in suspension0335
Total	3.1786

Schirmer (Le Sahara, p. 261) states that the mean salt content of well water at El Oued is 2.77 grams per liter.

SOILS.

The soil of the whole Oued Souf region is a fine-grained, light-yellow quartz sand, which is practically uniform in character to a considerable depth.^a Here and there beds of a coarse, rather soft, gypseous rock occur at a depth, it is said, of 10 to 20 feet and in strata 1.5 to 10 feet thick. The crystals of which this rock is composed are very large, often 1 foot long. They are often aggregated into masses which, on account of their shape, are known as "Souf roses."^b It is therefore a fair inference that the Souf soils are sufficiently rich in lime. They are very poor in organic matter and doubtless in nitrogen. Other data as to their composition are wanting.

In the eastern part of the region the soil of all the gardens is said to be somewhat saline, and the writer was told that there is even a small sebka (salt pond) in that section, although he saw nothing of these conditions. There is said to be nowhere enough salt to injure seriously the palms themselves, but the yields of fruit are diminished by this cause, and the dates are somewhat smaller and of slightly inferior quality. Consequently, palms in full bearing in the gardens west of El Oued are worth from two to ten times as much as those in the gardens east of that town. The Souafas do not pretend to distinguish some varieties of the date palm as being more resistant to salt than others, as do the inhabitants of the Djérid oases, where the salinity of the soil is often very pronounced. Neither have they adopted any special methods of preparing and handling salt land by drainage, flooding, or otherwise, as is the case in the Tunisian oases. It is fortunate for the Souafas that their soils are not saline, or but very slightly so, as it is hard to see how they could possibly reclaim strongly saline lands in view of the conditions of water supply in their country.

THE DATE GARDENS.

Let us now have a closer look at the gardens. (Pl. III, figs. 1 and 2.) The craterlike basins which they occupy are generally circular or nearly so, and from 35 to 50 feet deep. The bottom is entirely given up to the palms. Descending to the floor of the basin,

^aAccording to Jus this hard quartz sand extends to a depth of 3.5 to 4.5 feet; next there are from 7 to 8.5 feet of a "reddish gypseous sand;" and then 3 to 3.5 feet of either "a fine quartz sand" or "a yellow gypseous sand."

^bThe composition of this rock, as given by Jus (*ibid.*, p. 69), is:

	Per cent.
Quartz sand-----	37.00
Clay -----	5.10
Gypsum -----	41.40
Carbonate of lime-----	3.20
Carbonate of magnesia-----	1.50
Water -----	11.43

or "ghitan," as the natives term it, we find it to be a practically level expanse of clean, bare sand, checkered with the bright sunlight and the singularly black shadows that are cast by the trunks and leaves. (Pl. V, fig. 1.) The palms stand farther apart than in the gardens owned by natives in the Djérid and the Oued Rirh, but are not planted in rows and at equal intervals, as in the French plantations in the latter region. While native gardens elsewhere in the Sahara are a perfect jungle of various fruit trees, besides garden vegetables, barley, and alfalfa underneath the palms, in the Oued Souf one sees only scattered pomegranate and fig trees, and the groves have an unfamiliarly open and bare look. While in other oases the soil is often rich and black and is almost always moist, here it is quite dry on the surface. One misses, too, the irrigation and drainage ditches by which the gardens of the Djérid and the Oued Rirh are cut up into small plats.

Another feature of the Souf date orchards that immediately attracts attention is the enormous thickness of the trunks of the trees. They sometimes attain 3 feet in diameter. (Pl. V, fig. 2.) This is probably due to the trees being comparatively far apart, thus receiving plenty of light and air from every side, and is, perhaps, also to some extent a reaction to the buffeting of the sand-laden winds. At any rate, it is a useful character, giving the trees power to withstand the winds that prevail here to a greater extent than in the other oases of the northern Sahara. The relatively small height of the palms, which rarely exceed 30 feet in the Oued Souf, gives them a further advantage in this respect. Frequently, when the base of the trunk has become weakened and there is danger of the tree blowing down, the natives make a "dokana," or low, circular mound of soil, plastered on the outside, to strengthen it. (See Pl. V, fig. 1.)

The palms are almost invariably strong and healthy looking. The foliage is extraordinarily well developed, and the leaves commonly measure 15 to 20 feet long. The yields of fruit, as stated by the natives, are very heavy.

So unusual are the conditions under which date palms are grown in the Souf country that further details as to the methods used by the natives can not fail to be interesting.

PLANTING.

As the date palm is a tree that requires a great deal of water, it can evidently be grown in a dry country without surface irrigation only in places where its roots can quickly make their way to ground water. This is exactly the condition obtaining in the Oued Souf, where the palms are artificially watered only during the first summer after the offshoots are planted, and are then left to shift for themselves, so far as water supply is concerned.

As we have seen, the bottoms of the basins where the palms are grown are not only far below the summits of the surrounding sand hills, the height of which is increased by the sand removed in excavating the gardens, but are even considerably lower than the mean surface of the country. It is said that in starting a new garden the practice is first to sink a well in the bottom of the basin in order to find out the depth at which water stands. The floor of the basin is then scooped out until it is so near ground water that when a hole $1\frac{1}{2}$ to 4 feet deep is made to receive the young palm its roots will have to descend only about 1 or $1\frac{1}{2}$ feet to reach standing water. It is said that to attain the desired depth it is generally necessary to remove 10 to 20 feet of sand.

The date palm is always artificially planted in the Oued Souf, never springing up spontaneously from seed, as in other oases. It is never planted elsewhere than on the floor of the basins among the dunes, or at most a very few feet above the bottom. These basins are probably in all cases natural depressions, but are artificially deepened to facilitate the roots reaching ground water. New gardens are frequently started in unoccupied basins, and old ones belonging to enterprising owners are being constantly extended by cutting down the slopes of the bordering sand hills and planting a few palms every year or so. (See Pl. III, fig. 2.) The larger and better-situated basins are now all occupied by gardens, and for the newest plantations it is often necessary to use small, shallow depressions, where there is frequently room for but half a dozen trees. Sometimes the slope is not cut down quite to the level of the older part of the garden, the new palms being set out slightly above the level, on a terrace made in the side of the sand hills. (Pl. IV, fig. 1.) When planted on the slope or near the foot of it, sections of palm log or a number of palm leaves are placed on the uphill edge of the hole to check the drifting of sand into it.

Owing to the scarcity of offshoots in the Souf region, the work of extending the gardens does not proceed as rapidly as the energetic population could wish. The French attribute the nonproduction of offshoots in the Souf to the fact that the palms are so valuable there that it does not pay to let the offshoots develop, absorbing a part of the energy that would otherwise go to fruit production. They believe that the Souafas find it actually cheaper to send to the Oued Rirh for suckers, paying 40 to 60 cents apiece for them in addition to the cost of transportation, than to let them grow on their own trees. Economic considerations aside, however, it is probable that the date palm does not sucker as freely in the Oued Souf as in other oases, because of the dry condition of the surface soil, never wet by irrigation, and because the blowing sand tends to bury the young offshoots and to lacerate their tender buds. The natives, when questioned

about the comparative rarity of offshoots at the base of their palms, reply simply that it is due to the absence of irrigation, without going into details. Whatever may be the cause of the deficiency, there is a great demand for offshoots, and to supply this demand caravans are sent to procure suckers, especially of the Deglet Noor variety, to Tougourt, or even as far as Ouargla, 135 miles away. In those oases they are produced more freely, the palms being irrigated.

Offshoots for planting are generally taken from the mother palm about the end of February. The natives say that they could be planted even earlier, but in that case the parent tree is likely to suffer from the access of cold air to the wound made in cutting off the sucker. In case the offshoots are removed in midwinter, their bases are slightly charred before planting, and this is thought to protect them from the cold.

The hole made to receive the young palm is sometimes as much as 6 feet in diameter, but probably in most cases less. Its depth, as we have seen, depends largely upon the distance to ground water, being generally $1\frac{1}{2}$ to 3 feet in the bottom of the gardens near the town of El Oued. A young palm was seen near El Oued that had been set out near a well about 6 feet above the bottom of a garden, in a hole $3\frac{1}{2}$ feet deep. (See Pl. IV, fig. 1.)

The palms are not set out in straight lines. They stand much farther apart than in gardens belonging to natives in other oases, 20 feet being the average distance. This wide planting is probably necessitated by the poverty of the soil, which is practically a pure sand, while the almost entire absence of subsidiary cultures makes the shade afforded by close planting less valuable than in other oases.

It is estimated that the planting and care of a young Deglet Noor palm up to the time it begins to yield costs \$25 in the Oued Souf, as against \$5 to \$10 in the Djérid oases of Tunis.

CARE OF PALMS.

During the first summer after it is planted the palm may receive a few irrigations by hand with water from the well that is situated on the hillside in nearly every garden, although it is said that frequently no irrigation whatever is given. While still very small, before the leaves have grown out enough to project far above the mouth of the hole in which it is planted, the tree is protected from drought and from the cold of winter by covering the hole with palm leaves, dead pumpkin vines, etc.

When the palms are manured the sand that has piled up into a low mound around the base of the tree is removed and the soil beneath is thoroughly worked. This is apparently the only cultivation the trees receive.

FIGHTING THE SAND.

While elsewhere in the Sahara irrigation entails the heaviest labor connected with palm culture, in the Oued Souf it is the struggle that must be waged with the constantly encroaching sand that demands the tireless efforts of the gardeners. Every strong wind carries great volumes of sand. The slight fences of palm leaves and the low walls of gypseous rock that are constructed along the crests of the bordering dunes are only a partial protection against this invasion. Once over these weak barriers, the sand rolls down the steep slopes almost like water. The danger is always present, but is most pressing when the dates are ripening. Then bunches of fruit that hang close to the ground can be half buried by a few hours of high wind, and only the most strenuous efforts can save them. If a second storm occurs before the bulk of the sand is removed, the crop is hopelessly lost.

The work of cleaning out the basins is very laborious, being done, like the original excavation, almost entirely by hand. Travelers in this region have compared this work to the activities of ants, rather than of men. Laborers shovel the sand into baskets and carry them in a ceaseless procession to the top of the slope, their feet sinking deep into the flowing sand at every step. After a heavy sand storm the work must be continued from dawn to dark. In summer, during the blazing midday hours, the heat is too great for such heavy labor, and the removal of the sand goes on at night and in the early morning hours. At times a large part of the population of the region is engaged in this heavy task. It is paid for at the rate of 1 cent for every 5 baskets of sand, and the laborer has, in addition, the privilege of eating as many dates as he desires in the garden in which he is working. Only rich proprietors use the sturdy little gray donkeys of the Souf for transporting the sand from their gardens.

MANURING.

The soil of the Oued Souf is practically nothing but pure sand, containing even in the older palm gardens very little organic matter. Manuring is consequently essential not only to the production of good yields but even to the well-being of the palm itself.^a

It is not uncommon in the Souf country to see palms that have thick trunks up to a certain point, above which they contract more or less abruptly to a much smaller diameter. In many cases, at a still greater height, the trunk again becomes thicker. This state of things is explained by the natives as due to a partial starvation of the tree at

^a For that matter, manuring is generally practiced by good farmers in the oases of the Oued Rirh and the Djérid, although there the growing of leguminous food and forage crops (broad beans and alfalfa) helps to restore to the soil the nitrogen that is taken up by the palms.

the time when the trunk began to diminish in size. If manure is subsequently supplied to it, the palm is soon able to return to its normal rate of growth and the trunk again becomes larger.

Palms are not manured until they are 10 or 12 years old. At that age each tree usually receives 10 sacks (5 camel loads) of manure, half of which is applied on one side of the trunk the first year and the other half on the other side the following year. Thereafter, in order to obtain the highest yields, the trees should be manured every twelve or fifteen years, although sometimes thirty years are allowed to elapse between two manurings. Older palms receive as much as 14 sacks of manure (7 at each application). Camels' dung (see Pl. IV, fig. 2) only is used for date palms in the Oued Souf, although in the oases of Tunis that of donkeys is preferred, the natives there considering camel manure injurious where irrigation is practiced. The cost of a sackful of camel manure in the Oued Souf was stated by one informant to be 25 to 30 cents, while another placed it at 40 to 45 cents. In either case it is evidently an expensive article.

Manure is never used until it is thoroughly rotted, and even then it is not allowed to come into direct contact with the base of the tree. It is placed in a hole that is dug to a depth of 3 to 6 feet below the general level of the floor of the basin and at a distance of 5 or 6 feet from the foot of the palm. When several neighboring palms are to be manured at the same time, the hole is dug in the center of the space among them, and is made so large that none of the palms is more than 6 feet distant from its edge.^a The hole is then filled with a mixture of one part manure and one part of a bright yellow sand called "baker," which is somewhat more loamy and probably contains more gypsum than the surface sand of the region, and is obtained at a greater depth. Unmixed manure is never used, even though thoroughly rotted, being considered injurious to the palm roots. The soil removed in digging the hole is never put back, being "dirty," as the natives express it.

October is considered the best season for applying manure, although March is also a good time. Unskillful growers sometimes manure their palms at other seasons, but this is thought to do more harm than good. Sometimes, unless the hole is opened and the manure removed as soon as the tree shows signs of injury, it is said to die from the effects of manuring at the wrong period.

The effect of manuring upon the yield is large and almost immediate. It is said that a tree which bears 200 pounds of dates one year will often give 400 pounds the season following if meanwhile manure

^a One such hole, freshly excavated at the time of the writer's visit, occupied much the greater part of the area among four palms, being 12 feet long and 5 feet wide. It was divided unequally by a narrow ridge of soil left in place. The object of this division could not be learned.

has been applied. No distinction between varieties is made in the Oued Souf in manuring, nor, so far as could be ascertained, in regard to other cultural practices.

HARVEST.

At the time of the writer's visit (November 22–26, 1904) the date harvest had been completed in all the gardens of the Souf country. The Deglet Noor harvest is said generally to begin about October 25. In the Tunisian oases, on the other hand, the harvest of Deglet Noor and Fteemy dates—the two most important varieties—was at its height in November, and continued throughout December and even the earlier part of January. Of course, in the latter case many of the dates were ripe long before they were gathered, and the long duration of the harvest was largely due to the relative scarcity of the expert labor required, the crop being many times as large as in the Souf. Yet it seems certain that in the Oued Souf, dates, especially the Deglet Noor variety, ripen earlier than in the Oued Rirh oases of Algeria or the Djérid oases of Tunis. This would be expected from the fact that the summer is drier and likewise hotter in the Oued Souf than in the oases of the Djérid. Furthermore, the situation of the gardens, in hollows bordered by hills of light-colored sand that are generally higher than the tallest palms, is favorable to an early ripening of the dates, as they must receive a great amount of additional heat by reflection from the soil. More perfect natural conditions for forcing fruit to early maturity could probably not be found in the world.^a

This greater heat and dryness of the Souf climate affect the fruit in other ways than merely by hastening its ripening. The dates produced are reputed to be the best grown in the Sahara. They seem, as a matter of fact, to be sweeter and at the same time drier and more solid than in the Djérid. This is especially true of the Deglet Noor, which is of decidedly firmer texture, containing less water. The Souf dates are said to keep better and to be more adapted to export than those of the other oases, showing less tendency to blacken and become moldy.

It was a matter of regret to the writer that the harvest was not witnessed in the Souf, although it could not be learned that the methods followed there differ from those practiced in other oases. So far

^a Rolland (*Hydrologie du Sahara Algérien*, Paris, 1894, p. 222) describes the basins as "a sort of fiery furnace, under the influence of solar radiation. The dates here attain perfect maturity. Here are realized, better than anywhere else in the Sahara, the conditions assigned by the Arab proverb to the prosperity of the palm and the excellence of its fruits: 'Its feet in the water and its head in the fire of heaven.'"

as is known, the pollination of the female flower clusters in the spring is also effected in the same way as in the Oued Rirh.^a

YIELDS.

It was impossible to secure very reliable statements of yields from the natives, but from all that could be learned these must be unusually large in the Souf country. The clusters of the Deglet Noor are said frequently to weigh over 55 pounds each, and to attain sometimes 90 pounds. Single trees of this variety, which is one of the lightest bearing kinds, sometimes yield as much as 330 pounds in the Oued Souf. It was estimated in 1883 that the date crop from the 175,000 palms (of all varieties) in full bearing then existing in the Souf region was 7,000,000 pounds. This would mean an average yield of 40 pounds per tree, as against an average yield of 28 pounds estimated to have been produced in the Oued Rirh the same year.^b A good palm in full bearing is valued at from \$50 to \$130, according to the variety to which it belongs.

The practice of planting the trees farther apart than in other oases is perhaps one reason for the large yields. By wide planting, not only do the roots of each palm have a larger feeding area, but the trees do not shade each other so much and more of the fruit can develop and ripen. Moreover, the climatic and topographical conditions, as we have seen, are exceptionally favorable to the ripening of dates.

VARIETIES CHIEFLY GROWN.

As has already been indicated in this paper, date palms in the Oued Souf rarely, if ever, spring up from seed, as they do in other oases where the conditions are more favorable to the spontaneous development of the palm. They are propagated only by offshoots that are taken from the parent tree and planted by the grower. Consequently we do not see a multitude of seedlings, generally of very inferior quality and of almost endless diversity of characters, filling every waste corner and roadside and even crowding out good trees in gardens that are not well cared for. Practically every palm grown in the Souf belongs to some well-known and well-liked variety.

The number of varieties found in this region is considerable. Most of the gardens contain a mixture of several kinds, although in some of the recently created ones the tendency is to plant only one

^a Described in Bul. 53, Bureau of Plant Industry, "The Date Palm," by W. T. Swingle, 1904, pp. 26-29.

^b These estimates are quoted from Rolland (*ibid.*, p. 324). The overwhelming importance of the date crop in the Souf region is shown by the fact that the same author states the value of the 1883 crop of dates to have been \$301,730, while that of all other crops combined was only \$20,900 in that year.

sort, most often the Deglet Noor. Nearly all the popular varieties of the Souf are also common in the Oued Rirh.^a

On the other hand, some of the most characteristic Souf types are very rare in the Djérid oases of Tunis, only 70 miles away. Such individuals as occur there are mostly grown from offshoots that have been brought directly from the Souf. The principal variety common to the two regions is the Deglet Noor, which is now abundant in Tunis, but is said to have been first introduced into that country from Algeria about two hundred and fifty years ago. The Souafas still go to the Oued Rirh oases to procure offshoots, and they very likely brought thence those with which the first gardens were started among the sand hills of the Souf.

The most important of the numerous varieties of the Souf, in point of abundance as well as of quality, are, in about the order named: Deglet Noor, Rhars, Tafazween, Massowa, Deglet Beida, and Taker-mest. Of these Rhars is the earliest and Deglet Noor the latest to ripen. After the Deglet Noor, Tafazween is the best sort that is widely grown. It is a large, reddish-bay-colored, translucent date, very sweet and rich in flavor.^b A highly esteemed but very rare variety is the Fezzani, which is said to be superior even to the Deglet Noor when dried, and to keep well for two years. Rhars, a variety that is celebrated for its heavy yields, is extensively planted.

In the Oued Souf, as in other oases of Algeria and Tunis, the Deglet Noor is the only variety that has any importance as an article of export to Europe. It is consequently the most valuable, the more so because the natives themselves generally esteem it above all others. Deglet Noor dates are carried from the Souf by caravan to Biskra, whence they are shipped by railway to the seaports. Souf Deglets are said to be about the earliest to reach the Biskra market. Their good keeping and shipping qualities have already been discussed as probably due to the peculiar climatic conditions, which give them an advantage over dates from oases where the palms are lavishly irrigated and the air is moister. On the other hand, they appear to be smaller than those in the Djérid and to be inferior in color and general appearance. The latter disadvantage is very likely due in great part to the sand-laden winds to which they are exposed. The Deglet Noor palm is said to be hardier in the Souf region than elsewhere, showing greater resistance to disease and to unfavorable climatic conditions. The foliage of the date palm appears to be less subject to the attacks of scale insects than in other oases, which is perhaps attributable to the extreme dryness of the atmosphere.

^a Exceptions are said to be the Fezzani, Massowa, Ali Rashid, and Guettara varieties.

^b Twenty offshoots of this variety were obtained from the Oued Souf for trial in the United States through the kindness of the French commandant at El Oued, Captain Bussy.

CONCLUSION.

The type of agriculture practiced in the Oued Souf is not dry-land farming, for it depends upon the ground water, which in the gardens is everywhere near the surface of the soil. It affords us, however, an excellent object lesson of what can be done under the most adverse natural conditions in producing a valuable crop, for throughout northern Africa the Oued Souf is renowned for the large yields of its date orchards and the high quality of their fruit.

It may be that nowhere in the United States are the conditions with respect to ground water such as to allow of a close imitation of agricultural methods used in the Souf country. One lesson is, however, to be drawn from them. The sand hills concentrate and reflect so much heat that the hollows among them are veritable forcing houses, where dates ripen considerably earlier than elsewhere. Have we not here a hint of what may be done in the Salton Basin and perhaps in other hot, arid regions in the Southwest where large sand dunes exist, and where artesian or other sources of water supply for irrigation are available? It seems certain that in pockets of this character excavated among the dunes the Deglet Noor and other valuable varieties of dates could be forced to early maturity.

Dates ripened in this way a few weeks ahead of the bulk of the crop would command a fancy price, especially as the quality of the fruit produced under these conditions would in all probability be exceptionally fine. Nor are the possibilities limited to the date palm. Other fruits, such as figs, pomegranates, and grapes, could perhaps thus be put upon the market in advance of those from any other locality in the United States. The experiment is certainly worth trying. The American fruit grower, awake as he is to every new idea, may find something worthy of imitation in the example of these sturdy inhabitants of a remote corner of the Sahara.



PLATES.

DESCRIPTION OF PLATES.

PLATE I. (*Frontispiece*.) General view of the Oued Souf region from the town of El Oued, showing sand dunes and sunken gardens of date palms.

PLATE II. Fig. 1.—High sand dunes east of El Oued. The group is standing on a ridge separated by a ravine from the very high dune in the background. Fig. 2.—A typical dwelling house of the Oued Souf, showing its cubical form and roof composed of flattened cupolas. Fig. 3.—General view of the Oued Souf region, showing sunken date gardens and sand dunes. Fence of dead palm leaves along crest of dune in foreground.

PLATE III. Fig. 1.—Near view of sunken palm garden and surrounding dunes. Vegetable garden in left foreground, showing small size of checks. Near it a young palm, planted in a hole. Fig. 2.—Gradual extension of a palm garden by cutting down bordering sand hills. Oldest palms in background, youngest in foreground. Fig. 3.—Vegetable garden irrigated by well near bottom of basin in which date palms are grown.

PLATE IV. Fig. 1.—Hole on slope of dune near bottom of basin in which a young palm is planted. Fig. 2.—Camel manure ready for application in a date garden.

PLATE V. Fig. 1.—“Dokana,” or mound of earth and plaster for strengthening the base of a palm. Shows also distance between trees, absence of other cultures, and play of light and shadow on floor of basin. Fig. 2.—Rhars palm, showing thickness of trunk.



FIG. 1.—HIGH SAND DUNES EAST OF EL OUED.



FIG. 2.—A TYPICAL DWELLING HOUSE OF THE OUED SOUF, SHOWING ITS CUBICAL FORM AND ROOF COMPOSED OF FLATTENED CUPOLAS.



FIG. 3.—GENERAL VIEW OF THE OUED SOUF REGION, SHOWING SUNKEN DATE GARDENS AND SAND DUNES.





FIG. 1.—NEAR VIEW OF SUNKEN PALM GARDEN AND SURROUNDING DUNES.



FIG. 2.—GRADUAL EXTENSION OF A PALM GARDEN BY CUTTING DOWN BORDERING SAND HILLS.



FIG. 3.—VEGETABLE GARDEN IRRIGATED BY WELL NEAR BOTTOM OF BASIN IN WHICH DATE PALMS ARE GROWN.



FIG. 1.—HOLE ON SLOPE OF DUNE NEAR BOTTOM OF BASIN IN WHICH A YOUNG PALM IS PLANTED.



FIG. 2.—CAMEL MANURE READY FOR APPLICATION IN A DATE GARDEN.



FIG. 1.—"DOKANA," OR MOUND OF EARTH AND PLASTER FOR STRENGTHENING THE BASE OF A PALM.



FIG. 2.—RHARS PALM, SHOWING THICKNESS OF TRUNK.

